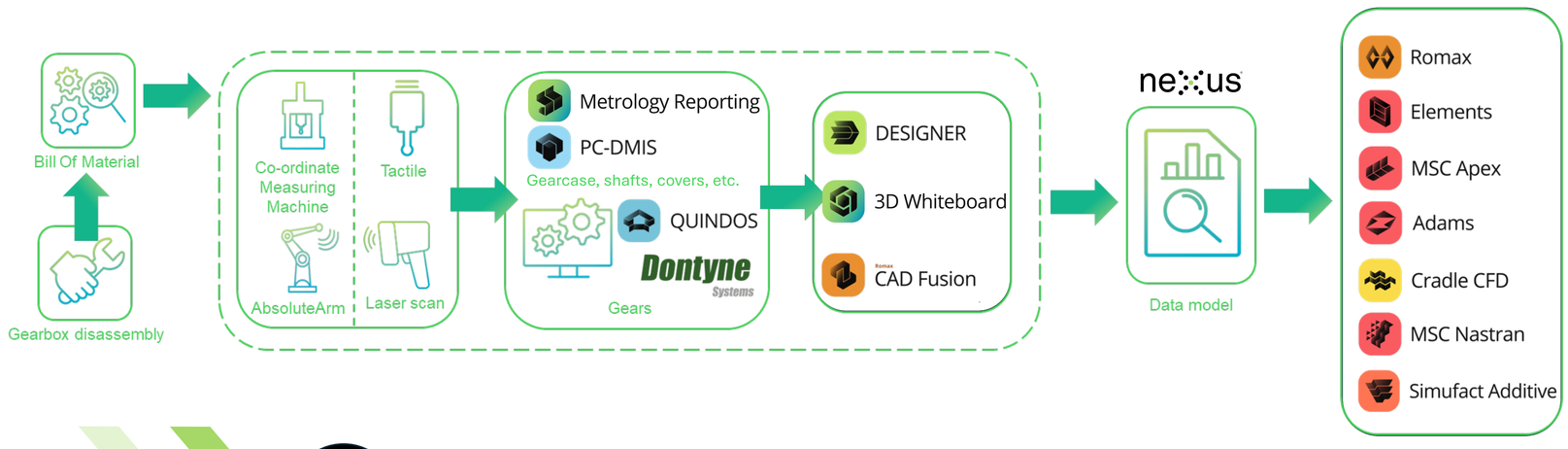
Reverse Engineering (RE) & Analysis of an Automotive Electric Drive Unit

Conventional methods for RE are manually intensive, time consuming and error prone

Modern metrology capabilities enable a seamless digital process for RE and creation of digital twins

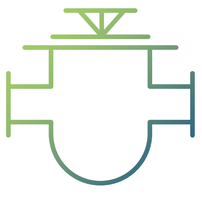


1 Measurement Device

GEARS

CMMs for fine detail of tooth geometry

CASING and OTHER



Portable devices for fast geometry capture

2 Inspection data capture

I. Combined tactile and scanned measurement data:

Tactile: For machined surfaces requiring higher precision (joint faces, bearing bores, bolt holes)

Scan: For free-form surfaces (cast surfaces)

II. Constructed features generated from measured data:

Gear shaft axes to find centre distances

P.C.D. of holes

Projected points onto datum faces

III. Form error measurement:

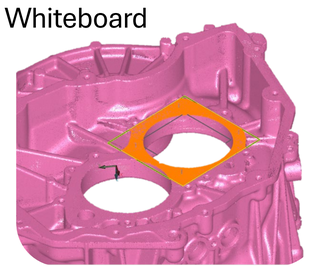
Squareness and parallelism of shaft axes

Flatness and parallelism of joint faces

Roundness of bearing bores

IV. Generation of CMM-type report

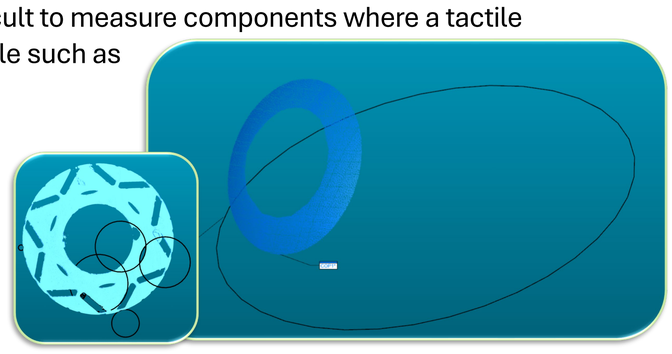
Report generated via Nexus metrology reporting and reviewed collaboratively in 3D Whiteboard



3 Cloud point data measurement

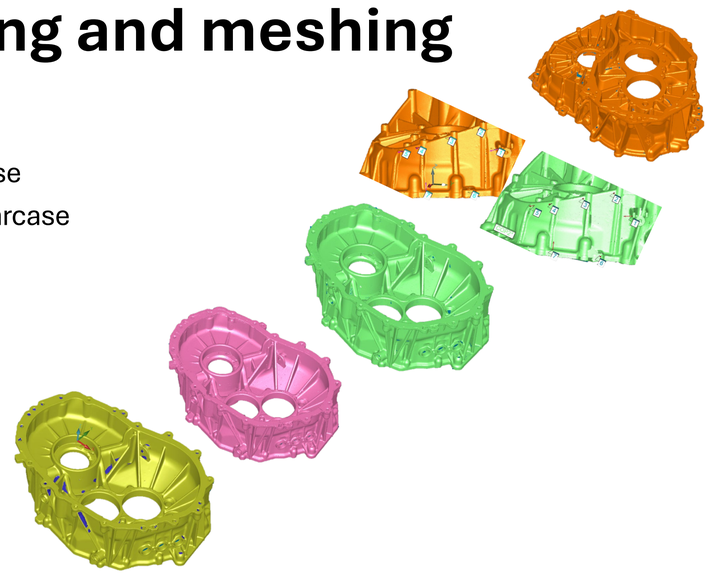
Features may be generated directly from cloud point data:

- Ideal for lightweight or difficult to measure components where a tactile measurement is not possible such as
  - **Rotor Laminations**
  - **Differential washer**



4 Scanning, aligning and meshing

- Full laser scan of top half of gearcase
- Full laser scan of bottom half of gearcase
- Alignment of top & bottom
- Clean up and filter
- Mesh



5 Post scan processing

Mesh imported from PC-DMIS into DESIGNER

- Requires processing to create a closed mesh

Remove surface reflections

Fix internal fold-overs

Remove open meshes

Fill voids

6 Mesh optimization

Closed mesh is refined, smoothed and optimised:

- Removes outliers
- Increases triangle size to reduce processing time
- Smoothens rough edges and curves

Mesh converted to a solid and imported into CAD and Hexagon simulation software as a STEP file for CAE analysis

7 Gear data collection

Leitz PMM-C CMM delivering fast, ultra-high accuracy results

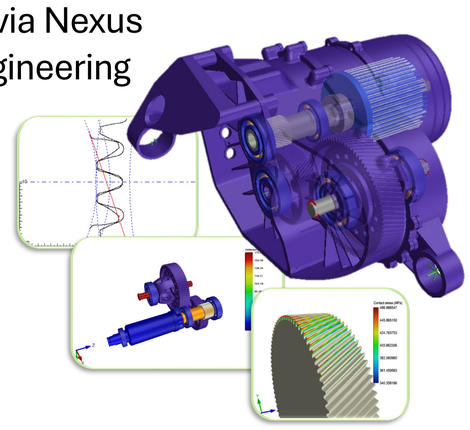
- Gears measured for: Profile, Lead, Circular pitch and run-out

Gear graph data imported into Romax software to create macro and micro geometry

8 Engineering analysis

Digital twin imported into analysis software via Nexus Cloud portal which connects the reverse engineering process for assessment in different physics under different loads and duty cycles.

- Outlining manufacturing and assembly processes
- Assessment of design choices



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3DMC 2024 - Loughborough